CONTROL OF AIR CONDITIONING SYSTEM WITH LIMITED NUMBER OF DISCRETE INPUTS

BACKGROUND OF THE INVENTION

The invention relates to heating, ventilation, air conditioning and refrigeration (HVAC & R) systems and, more particularly to a system and method for operating a system which has a limited number of control inputs.

Conventional systems may frequently have only a discrete number of inputs which can be utilized to signify control actions of the device. For example, certain HVAC & R systems have, and can read, only two discrete inputs which signify the desired amount of cooling needed or desired in a particular space. Further, third party controls and thermostats typically only have two outputs for use in issuing such inputs to the air conditioning system. Thus, with two inputs, the conventional system must decide as to how it is to be operated.

Such systems can frequently have three or more stages or vapor compression circuits, and when the number of stages exceeds the number of inputs, the flexibility of operation of the device is limited.

The need exists for an improved method for operating such a system, to provide suitable control for all possible states of operation for same.

It is therefore the primary object of the present invention to provide such a system.

It is a further object of the present invention to provide a method for operating a multi-stage having limited numbers of inputs so as to provide expanded ranges of operation of same.

Other objects and advantages of the present invention will appear hereinbelow.

SUMMARY OF THE INVENTION

In accordance with the present invention, the foregoing objects and advantages have been readily attained.

According to the invention, a method is provided for interpreting input on an X input multi-stage HVAC & R system to control Y stages of the system, wherein Y is greater than X. This method comprises the steps of receiving input from X inputs; translating said input into a binary system having Y binary outputs; and controlling said system based upon said binary outputs.

In further accordance with the invention, an HVAC & R system is provided which comprises a multi-stage system having X inputs; and Y stages, and wherein Y is greater than X; and a processor adapted to receive said X inputs, translate said X inputs into a binary system, and use said binary system to control said Y stages.

BRIEF DESCRIPTION OF THE DRAWINGS

A detailed description of preferred embodiments of the present invention follows, with reference to the attached Figure 1, which schematically illustrates a system and method in accordance with the present invention.

DETAILED DESCRIPTION

The invention relates to heating, ventilation, air conditioning and refrigeration (HVAC &R) systems and, more particularly, to such systems and a method for operating such systems whereby limited number of control inputs can be used to independently control a greater number of stages of the system.

Figure 1 shows a system 10 including a multi-stage cooling system 12 and a thermostat 14 which is used to control operation of multi-stage system 12.

System 12 includes a plurality of stages 16, 18, 20, in this case three stages, each including a compressor and typical components of a vapor compression circuit for providing the desired cooling function. System 12 further includes a microprocessor 22 which is communicated with stages 16, 18, 20, and also with thermostat 14. Microprocessor 22 advantageously serves to receive input from thermostat 14 and use this input to control stages 16, 18, 20 as will be further discussed below.

As identified above, thermostat 14 is frequently a device with a limited number of outputs, in this case labeled as y1 and y2. Further, conventional systems typically have a limited number of inputs for receiving such input and microprocessor 22 in this invention is shown having a like number of inputs as the output of thermostat 14. Thus, inputs 24 of microprocessor 22 are adapted to receive output from thermostat 14, and to translate this input into a greater number of outputs which can be used to more flexibly control the different stages of system 12 as desired.

In accordance with the invention, the inputs y1, y2 are translated or converted into a binary system which can then be used to signify a relatively greater number of different commands that can be conveyed to the different stages of system 10.

This is more clearly illustrated in Tables 1, 2 and 3 set forth below.

TABLE 1

Standard control system (Option 1)

Y1	Y2	# of stages
0	0	0
1	0	1
0	1	3
1	1	3

TABLE 2

Standard control system (Option 2)

Y1	Y2	# of stages
0	0	0
1	0	2
0	1	3
1	1	3

TABLE 3

Binary control system

Y1	Y2	# of stages turned on by the microprocessor
0	0	0
1	0	1
0	1	2
1	1	3

Table 1 shows one configuration of a conventional control system wherein the microprocessor typically turns on the first stage of cooling when the y1 input is on, and turns on all stages of the system when the y2 input is on. Thus, in such system, the y1, y2 inputs can be used to control the system with only one or three stages active.

In a reverse of the configuration of Table 1, the y1 input can be configured to turn on two stages, while the y2 input turns on all stages. This provides for operation with two or three stages of the system active.

It should be readily apparent, however, that the configurations of Tables 1 and 2 do not allow for operation of the system with each of 0, 1, 2 and 3 stages active.

In accordance with the invention, the inputs are translated into a binary control system such as that illustrated in Table 3 above, whereby the combination of different inputs has significance as well as the quantity of the input, so that the 2 signal input can be translated into 4 different commands. This advantageously allows for a 2 input system to operate with 4 different levels of stages in operation as illustrated in Table

3, and is particularly advantageous as compared to conventional control systems.

It should be readily appreciated that the system and method of the present invention can advantageously be adapted to systems having a greater number of inputs and still further greater number of stages. For example, a system having 3 inputs can be provided in accordance with the invention whereby the 3 inputs are translated into 8 different distinct commands of a binary control system so that 8 stages of cooling can be provided. Similarly, a 4-input system can handle sixteen different stages.

This can further be advantageously be incorporated into systems which have both cooling and heating capacity and stages, and preferably which have multiple stages of each. Under such circumstances, a limited number of inputs can be utilized to control multiple stages of cooling, multiple stages of heating, and combinations thereof.

In such a system, for example a system having 4 inputs and 3 stages each of heating and cooling, conventional systems cannot be used to provide completely flexible operation of each of different stages. In accordance with the present invention, however, and as illustrated in Table 4 below, the input from stages 1 and 2, along with a third input indicating cooling or no cooling, can be used to provide flexible operation of each and all stages of the system, while leaving the fourth input advantageously available for use for a different piece of information.

TABLE 4

Stage Input #2	Stage Input #1	Cooling?	# of Cool Stages	# of Heating Stages
0	0	0	0	0
0	1	0	0	1
1	0	0	0	2
1	1	0	0	3
0	0	1	0	0
0	1	1	1	0
1	0	1	2	0
1	1	1	3	0

Thus, it should readily be appreciated that the system and method in accordance with the present invention advantageously provide for operation of a system having X inputs so as to independently control Y stages of the system, wherein Y is greater than X, so as to provide enhanced flexibility of operation of the system without substantial complication of same.

Microprocessor 22 can advantageously be any type of processor unit advantageously adapted to be incorporated into an HVAC & R system, or can alternatively be provided as external hardware, or as a separate device communicated through various electronic communication means.

Furthermore, thermostat 14 can be any type of air conditioning or building control system, smart thermostat, and the like.

Still further, it should be appreciated that the system and method of the present invention can be incorporated into existing systems and/or incorporated into new systems, as the system and method of the present invention readily provide for incorporation or retrofit into existing systems.

It is to be understood that the invention is not limited to the illustrations described and shown herein, which are deemed to be merely illustrative of the best modes of carrying out the invention, and which are susceptible of modification of form, size, arrangement of parts and details of operation. The invention rather is intended to encompass all such modifications which are within its spirit and scope as defined by the claims.